Physics 250: Computational Physics

Instructor: David W. Miller, PRC 245,
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Lecture Times:	Tue–Thur 2:00pm–3:20pm
Lecture Location:	KPTC 309 (Kersten Physics Teaching Center)
Textbook:	None required, many suggested! (see Reading List)
Canvas Course Site:	https://canvas.uchicago.edu/courses/16987
Course GitHub Site:	https://github.com/UChicagoPhysics/PHYS250
Course JupyterLab:	https://ml.maniac.uchicago.edu/index.html
Piazza Site:	https://piazza.com/uchicago/fall2018/phys250
Prof. Office Hours:	Tue. 3:30pm–4:30pm, and by appt.
Computer Lab Hours:	Help is available specifically for PHYS 250 by TAs in the Computer Science Instructional Lab (CSIL), 1st floor of Crerar, on: Tue 7:00-9:00 pm in CSIL 1 Wed 2:30-4:00 pm in CSIL 2 Wed 7:00-9:00 pm in CSIL 1
Teaching Assistants:	See the *Additional Information* section.
Description:	This course introduces the use of computers in the physical sciences. After an introduction to programming basics, we will cover numerical solutions to fundamental types of problems, techniques for manipulating large data sets, neural networks, and the basics of data analysis.
Homework (70%):	***Canvas:*** Problem sets and materials are available on Canvas and via GitHub. ***Due Date:*** **Thursdays**. Graded homework will returned the following week. ***Collaboration Policy:*** Collaboration on issues, concepts, and approaches is encouraged, but the work *must be your own.*
Final Project (30%):	Weeks of Dec. 3rd and 10th (*Details TBD*)

Tentative Course Outline:

The weekly coverage is subject to changes and adjustments as the course progresses.

Week	Week Of	Lecture Topics, Exams, Information
Week 1: Lec 1–2	Mon Oct 1	• Algorithmic thinking, programming structures • Python, Jupyter, Unix, shell, git • **Relevant reading:** KN 1.1; LPB 1.5, 5.2,
Week 2: Lec 3–4	Mon Oct 8	• Software design concepts, visualization • Random number generators, errors • **Relevant reading:** KN 6.2; LPB 2.1
Week 3: Lec 5–6	Mon Oct 15	• Ising model, Metropolis algorithm • **Relevant reading:** Sethna 8.1; KN 6.4; LPB 15.1-15.4
Week 4: Lec 7–8	Mon Oct 22	• Minimization and the Monte Carlo method • **Relevant reading:** Franklin 12.1-12.6
Week 5: Lec 9–10	Mon Oct 29	• Ordinary differential equations • **Relevant reading:** Franklin 2.1-2.6; KN 6.8; LPB 7.1-7.10, 9.1-9.8
Week 6: Lec 11–12	Mon Nov 5	• Partial differential equations • **Relevant reading:** Franklin 4.1-4.4; LPB 17.1-17.19
Week 7: Lec 13–14	Mon Nov 12	• Fourier transforms • Data analysis techniques • **Relevant reading:** Franklin 7.1-7.7; KN 4.1-4.3; LPB 10.1-10.10
Week 8: Lec 15	Mon Nov 19	• **Holiday:** Thanksgiving, Thursday Nov 22 • Data analysis techniques • **Relevant reading:** KN 4.1-4.3, 8.2
Week 9: Lec 16–17	Mon Nov 26	• Neural networks • **Relevant reading:** Franklin 14.1-14.6
Week 10: Lec 18–19	Mon Dec 3	• Invited speaker, Final project presentations • **Relevant reading:**
Week 11	Mon Dec 10	• Final project presentations

Recommended References:

- Press, *Numerical recipes : the art of scientific computing*
  - `QA297.N866 2007`
  - available in a limited form online here
  - python resources & exercises here
- Sethna, *Statistical Mechanics: Entropy, Order Parameters, and Complexity*
  - `QC174.8.S48 2006eb`
  - available as a PDF here
  - computational resources & exercises here
- Kinder & Nelson (KN), *A Student's Guide to Python for Physical Modeling*
  - ISBN: 9781400889426
  - computational resources & exercises here
- Franklin, *Computational Methods for Physics*
  - ISBN: 9781139525398
  - computational resources & exercises here
- Landau, Paez, Bordeianu (LPB), *Computational Physics, Problem Solving with Python*
  - `QC20.82.L36 2007`
  - computational resources & exercises here
  - The text book in the Library is actually, *Computational Physics, Problem Solving with Computers (2nd Ed.)* but the updated online version is more useful, I think
- Halterman, *Fundamentals of C++ Programming*
  - available as a PDF here
  - computational resources & exercises here

Supplementary Math Texts (can be helpful for algorithms):

- Arfken & Weber, *Mathematical Methods for Physicists* `QA37.2.A740 1995`
- Greenberg, *Advanced Engineering Mathematics* `TA330.G725 1998`

Additional Information for the Course:

Teaching Assistants (TA):

TA's will have office hours as well as be available in the CSIL lab for assistance.

TA Name Email	Office Hours	CSIL Lab Availability Last Names

Schedule and Section Assignment Information:

- Discussion Sections will begin meeting in Week 2 of Spring Quarter. Room assignments will be posted on the bulletin boards outside KPTC 106.

Piazza

This term we will be using **Piazza** for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself.

- Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza.
- If you have any problems or feedback, email myself or the Piazza developers: team@piazza.com
- Find our class page at: https://piazza.com/uchicago/fall2018/phys250

Miscellaneous

- Students with special needs or who may need extra time on any exam or other deadlines should alert me during Week 1 or as soon as possible after enrolling in the course.